Tri-Service

Ecological Risk Assessment Workgroup

Annual Update
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The TSERAWG ECO NEWSLETTER is a yearly report of the proceedings of the Tri-Services Ecological Risk Assessment Work Group. It is published by the collaborative efforts of the editors. There are three types of articles appearing herein. They are either activity summaries or editorials written by TSERAWG members specifically for the publication or they are abstracts of presentations given during a Work Group meeting.

Welcome to the Tri-Service Ecological Risk Assessment Work Group

Mark Johnson, PhD
U.S. Army Center for Health Promotion and Preventative Medicine

The Tri-Service Ecological Risk Assessment Work Group (TSERAWG) has been meeting since 1996. It was officially chartered in January of 1997 by the Tri-Service Environmental Support Centers Coordinating Committee. The Work Group is organized to share experiences and to coordinate and develop uniform technical guidance for the conduct of ecological risk assessments (ERA) within the military community. The TSERAWG also provides technical information transfer to member organizations regarding the latest on ERA applications and participates in technical reviews of various ERA techniques and methods.

Notes from the Chair

Doris A. Anders (Andy), PhD
Air Force Center for Environmental Excellence, Headquarters

The Tri-Service Environmental Risk Assessment Workgroup (TSERAWG) is an excellent Department of Defense (DoD) networking forum. All aspects of risk assessment – from laboratory experimental design to the finished documentation – are regularly presented and thoughfully discussed among representatives of the Services, regulatory agencies, and technical consultants, during our quarterly meetings. We are a group of idealistic, enthusiastic, multi-talented, and genuinely warm and friendly people, and we always welcome new members and guests.

As part of our efforts, we have published under a "purple" cover (Army, Navy, and Air Force Service Center logos) documents developed by one of the Services or jointly developed by the Workgroup. The current effort is the *Development of Terrestrial Information for the Army Risk Assessment Modeling System (ARAMS)* under development by the U.S. Army Center for Health Promotion and Preventative Medicine (CHPPM), in conjunction with the U.S. Army Corps of Engineers Engineering Research and Development Center (USACE ERDC-WES). Recent past "purple" documents include the *Tri-Service Remedial Program Manager's Handbook for Ecological Risk Assessment*, and the *Guide for Incorporating Bioavailability Adjustments into Human Health and Ecological Risk Assessments, Part 1: Overview of Metals Bioavailability and Part : Technical Background Document for Assessing Metals Bioavailability*.

For information on how to join us – or just visit! – please contact the individual Service points of contact, or either of the TSERAWG co-Chairs. We'd be happy to see you, and welcome your participation!

- Doris A "Andy" Anders, PhD, HQ AFCEE, Brooks City-Base, San Antonio TX (Chair)
- Ron Checkai, PhD, Army ECBC, Aberdeen Proving Ground, MD (co-Chair)

Physical Form of Lead on Small Arms Ranges: Transport and Treatment Implications

Steven L. Larson, PhD
U.S. Army Engineer Research Development Center
January 2004

The Department of Defense (DoD) operates more than 2,600 small arms firing ranges (SAFRs) nation-wide. Bullets contain lead are often fired into earthen berms. The subsequent accumulation of lead and its potential for release into the environment presents concerns with regards to human health and the environment. The research identifies the effects of soil type, climate, and aging time on the physical form of lead in SAFR earthen berms as well as the forms of lead produced in a single soil type by M-9 handgun, M-16 rifle, and M-60 machine gun training. These range factors will be related to the potential mobility of lead from the range.

Using M-16 weapons, bullets were firing into six soil types at a set firing distance. Following firing, the soils were analyzed using gravimetric, inductively couple plasma spectroscopy, sequential extraction, size fractionation, x-ray diffraction, and scanning electron microscopy in order to determine the physical form of lead in each soil and the properties of those forms. A training site that has three co-located SAFRs; a M-9, a M-16 and M-60 firing range was used for comparison of specific weapons training with the physical forms of lead present in each range soil using the techniques listed above. Each of the soils was characterized by total lead concentration, particle size, lead species (carbonate, Fe-Mn associated, organic/sulfide, exchangeable, and metallic), distribution by particle size, cation-exchange-capacity, and pH. Lead distribution by particle size correlated with the projectile energy of each weapon type and the mass of lead mobilized with sediment movement.

The physical properties of the lead in range soils have implications with regards to lead transport and soil treatment. Use of chemical stabilization treatments that reduce lead solubility will be most effective at reducing lead transport where the mobile lead on the range is water-soluble. For soil types where lead is sparingly soluble, sediment transport reduction measures may be indicated. Physical separation by lead particle size may be effective for slow moving rounds in soft soil types but useless for high velocity rounds fired into abrasive soils. Understanding how range use, soil chemistry, and particle size distribution effect lead mobility and treatment can enable range managers to make informed decisions how best to reduce lead transport from or remediate range soils.

An Ecological Risk Assessment of an Upland Shooting Range

Sherry Krest, Chris Guy, Dan Murphy, and Mark Huston
U.S. Fish and Wildlife Service
January 2004

The purpose of this risk assessment was to determine the ecological effects of lead shot and the associated lead-contaminated soil to biota found on a former trap range. Soil samples were collected from grid nodes spaced 30 m apart and analyzed for metals and for lead pellet counts. Soil was tested using a 28-day earthworm toxicity test in which survival and growth were measured. In addition, the concentration of lead that accumulated in worm tissue was measured at the end of the test. A 10-day plant toxicity test was also conducted in which survival and growth (stem height and root elongation) were measured. These tests were used to measure the direct toxicity of the soil. Food chain accumulation models were used to estimate the dose of lead in the food chain to both mammal and avian species. Lastly, lead pellet ingestion probability models were used to evaluate the risk to an avian receptor that consumes lead pellets for use as grit.

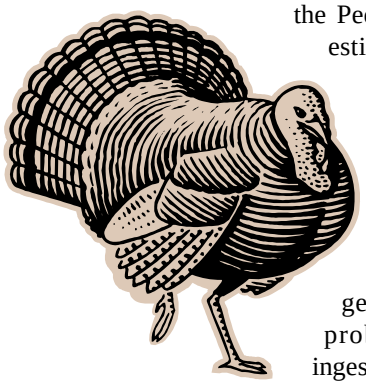
The results of the soil samples collected from the range indicate that the site has been heavily contaminated with lead (up to 100,000 mg/kg) and lead shot (> 65,000 shot/ft^2). Toxic responses were noted in the earthworm (reduced survival) and plant (reduced growth) toxicity tests. The hazard quotients calculated with food chain accumulation models using insectivorous birds and mammals exceeded 1. The results of the probability models indicated that terrestrial birds were at risk due to the ingestion of lead shot.

Based on the results of the studies, preliminary remedial goals (PRG) were developed for the clean up of lead contaminated soil and lead shot. A compilation of the LOAELs measured in the toxicity tests and from back calculation in the food chain models indicated that 421 mg/kg lead was the lowest goal. A compilation of the NOAELs calculated for the toxicity tests and from back calculation in the food chain models indicated that 310 mg/kg was the highest NOAEL below the lowest LOAEL. Therefore, the PRG was established between 310 mg/kg and 421 mg/kg for the protection of the endpoints evaluated in this risk assessment. By accepting an ingestion probability of 0.10, a PRG for lead shot will be established for the protection of upland birds.

Update on Ecological Risk Assessment Issues at Small Arms Ranges

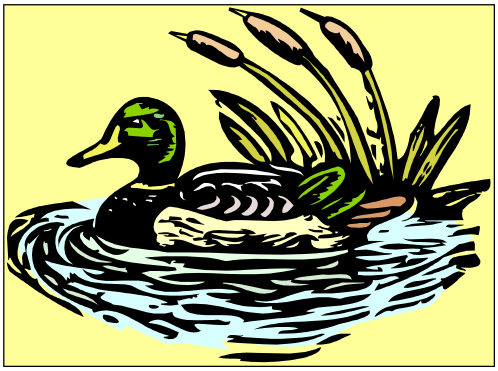
Michael Kelly
U.S. Army Environmental Center
January 2004

Two Fort McClellan small range sites (from 5 to 45 acres in size) were discussed that are problematic due to grit ingestion as a primary exposure route. The turkey and Northern Bobwhite were the assessment endpoints and they are using the Peddicord-Lakind model to help estimate grit retention time. The goal was to determine the number of grit per specified area that could remain without causing unacceptable risk to the birds. Some of the issues that were discussed they had to address in order to get a decision. These included probabilistic model assumes ingestion of one lead particle causes adverse effect; projectile fragmentation at Small Arms Ranges (SAR) may create particles of irregular shape and texture and not of a size the birds would eat; the model evaluates probability of individual ingestion and extrapolating to a population level is problematic; endpoints should be maintenance of a population density similar to a control area and not concern for single birds. There are a number of factors that impact whether a bird takes up grit or that ingestion of lead as grit is a problem including the grit size, type of diet throughout the year changes the amount of grit needed, and retention time of the grit in the bird. The issue now is how to turn this into a cleanup goal.



Using a Binomial Probability Model to Evaluate Risk at NAS Alameda Skeet Range

Jennifer Holder, PhD, BBL Sciences
Michael Pound, Naval Facilities Engineering Command Southwest
January 2004



This study evaluated the probability that diving ducks will ingest a toxic quantity of lead shot from the sediments at a Skeet Range located at the former Naval Air Station (NAS) Alameda in San Francisco Bay, CA. Based on their foraging behavior, diving ducks have the greatest potential for uptake of lead shot through incidental ingestion of sediment-borne lead shot or grit. A site-specific probability model was developed that focused on diving ducks (e.g., scaups and scoters) foraging in sub-tidal sediments. The probability model was developed from the binomial probability expansion formula and estimates the likelihood that a bird may ingest either grit or lead shot at every attempt to acquire grit. The binomial model output determined the probability that an individual receptor may ingest above the toxic quantity of lead shot before adverse effects are observed. Monte Carlo analysis was used to evaluate the uncertainty in the input parameters and the propagation of this uncertainty in the model outputs. Distributions for input parameters to the model were developed from the literature for the selected receptors or similar wildlife species. This exercise also included a sensitivity analysis that assessed the impacts of each parameter's uncertainty on the model output, and emphasized the need to consider such uncertainty explicitly in the characterization of risk at the site. The output of this model supported a conclusion of de minimus risk to diving ducks and a recommendation of no further action at the site.

Uptake of Antimony, Copper, and Lead into Plants, Invertebrates, Reptiles, and Small Mammals at a Small Arms Firing Range in Central California

Bridgette R. DeShields
HRT/Blasland, Bouck, and Lee, Inc.
January 2004

A study was conducted at the Inland Ranges, or Multi-Range Area (MRA), at Fort Ord, California to evaluate the uptake of lead, antimony, and copper into plants, insects, lizards, and small mammals from soil at firing ranges. This study was conducted to provide data for the ecological risk assessment (ERA) and in support of remedial planning efforts. Locations representing no, low, moderate, and high bullet cover range areas were sampled at three different types of firing ranges. The majority of the MRA consists of central maritime chaparral habitat. At each location, soil, plant, insect, lizard, and small mammal samples were collected. For plants, vegetative portions were collected. Insects were collected by a variety of techniques and composited. For a subset of the mammals, bone, kidney, feces, and remainder tissues were analyzed; whole body analyses were conducted on the remainder of the mammals and the lizards. All samples were analyzed for lead, antimony, and copper. Additionally, in vitro bioavailability tests were conducted on lead in soil from the 250 um sieve fraction at pH values of 1.5 and 4.5. Regression analyses were performed on the resulting data. In general, good correlations were found between tissues and both lead and antimony soil concentrations; most of the relationships were lognormal. Copper was not taken up to a high degree except where soil concentrations of copper were significantly elevated; therefore, the correlations between soil and tissue copper levels were poor. The highest concentrations of metals were found in biota collected from high bullet cover zones with a significant decrease in tissue concentrations in areas of lesser bullet cover. For small mammals, the highest lead concentrations were found in the bone while lead concentrations in the kidneys were below the screening level of 25 mg/kg. Lead was found at up to 872 mg/kg in plants, up to 485 mg/kg in insects, up to 220 mg/kg in lizards, and up to 23.5 mg/kg in small mammals. The in vitro tests showed that bioaccessibility decreases with increasing soil lead concentration at pH 1.5; an opposite relationship was shown at pH 4.5. Bioaccessibility ranged from 93 percent in the reference area to 26% in high bullet cover zones at pH 1.5 whereas the bioaccessibility ranged from less than 1 to 14.5 percent at pH 4.5. This data will be used in the ERA to estimate risks to ecological receptors and in an evaluation of the remedial alternatives using a net environmental benefit analysis (NEBA) to weigh risk reduction against habitat destruction.

Bioavailability of Lead and Copper at Military Firing Ranges

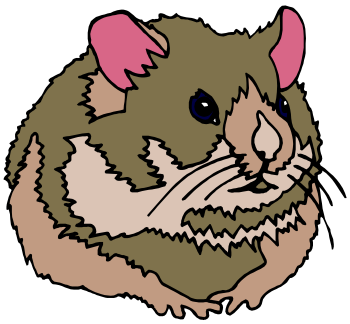
Dr. Desmond Bannon, PhD
U.S. Army Center for Health Promotion and Preventative Medicine
June 2004

An estimated 2,000 to 3,000 military small arms ranges exist in the continental U.S., ranging in size from a few to hundreds of firing lanes. These sites are all commonly contaminated with lead (Pb) and copper (Cu) from copper-jacketed lead bullets. Bullets can be whole, fragmented, or oxidized, and risk assessment methods attempt to address the health and environmental effects of these varied forms. Over time the ultimate fate of the metals is oxidation to compounds of Pb and Cu that interact with the soil particles, forming a vehicle for metal ingestion. Human health and ecological concerns primarily stem from exposure to Pb, although copper can also pose a hazard. How risk will be assessed depends on whether the targeted use is residential, industrial, or continued military. For Pb, well established human models of soil ingestion and absorption are used into which default parameters are placed, while ecological risk assessment relies on less precise exposure estimates and toxicity values, including the hazard quotient (a ratio of the estimated ingested dose of a metal to the dose of a metal supplied in a controlled laboratory toxicity study) for indicator species such as small mammals or birds. For Cu, no such models exist, and the hazard quotient is used. Relative bioavailabilty (RBA) measurements adjust the absorption of metals to account for chemical forms of the metal and soil properties of the site, using soluble salts as a reference. For Pb, this adjustment factor is based on in vivo swine surrogates of human digestion and absorption, allowing the setting of realistic and cost-effective cleanup goals. Current research focuses on the establishment of reliable in vitro methods for bioavailability assessment. A modified method for ecological receptors is also examined. For small arms ranges, rapid in vitro methods for bioavailability measurement would expedite decision-making and remediation.

How is Ecological Risk Being Assessed at Army Artillery Ranges

Keith Williams
U.S. Army Center for Health Promotion and Preventative Medicine
June 2004

Characterizing exposure and effects at artillery ranges is unique. It requires investigators to get everything they need in a very brief period (~ 6 days) due to active range operations. This requires a different approach from the tiered one commonly used in Ecological Risk Assessments (ERAs). Since the DOD is an important land trustee, encroachment issues require we have information regarding the potential for effects from training and testing. Acre for acre, DOD has the highest number of threatened and endangered species. Since human intervention and activity is controlled in these areas, they have become excellent habitat for many species. Training and environmental stewardship is not mutually exclusive. A total of 10 ranges will be characterized using a randomized grid approach to soil sampling. Soil, vegetation, and rodent populations are all sampled simultaneously. Captured male rodents are evaluated for target organ effects from energetic compound exposure. Sperm, liver, spleen, kidney, testes; evaluation of organ:body weight ratios, and capture/mark recapture techniques are evaluated and used. Rodent sperm analysis (RSA) is the field adaptation of method used by FDA to register new drugs. A 60%, 40%, and 4% reduction in sperm count, mobility, and morphology can lead to reduced fecundity, respectively. Traps are set in both impact and reference areas simultaneously. Exposures can come from deer licking low-detonation impact sites for salt and rodents using shells as nest sites. Based on the infrequency of positive results, plant sampling will cease. They are currently not looking for perchlorate residues in plants.



Performance-Based Contracting and How the Army is Applying it: Implications for the TSERAWG

Joan Jackson
Sourwood Solutions (U.S. Army Environmental Center Contractor)
June 2004

Risk assessments, particularly those at BRAC sites appear to almost go on indefinitely. Therefore, a change was needed that promoted completion and performance. Performance-based contracting (PBC) is a federal government-wide initiative based on the Governmental Performance and Results Act (1993), Federal Acquisition Streaming Act (1997), and President's Management Agenda. The Army is now committed to using PBC in completing risk assessments; "contract for "what," not 'how." PBC contracts clearly define performance expectations, due dates, milestones; use incentives; flexibility in exchange for accountability for results. At the Army Environmental Center (AEC), Contracting Officer Representatives (COR) may be at AEC or may be other Department of Army civilians whom will handle contracting details. The Acquisition "Tool Box" for PBC includes fixed-price remediation using Statement of Objectives and incentives. The goal is to complete the evaluation, provide the remedy, or institute long-term monitoring (LTM), and complete the 5-year review. Environmental insurance is a necessity should it be needed to protect against cost overruns. In Installation Restoration Program (IRP) history, there has been significant variation in program performance, cost-to-complete if increased (approx. $3.4B for Army now); current PBC contracts showing 85-90% completion of planned milestones, and no incentives for early or timely completion. The Army is hoping to streamline clean up through PBC, save funds, increase competition, maintain contracting flexibility, and hold contractors accountable for their performance. Regulators are invited to the initial scoping meetings with installation personnel and participate in development of performance measures, comment on draft Performance Work Statement; participate in Bidder's conferences to present regulatory views to prospective contractors, and, after the contract is awarded, continue to maintain an active role by reviewing remedial activities prior to implementation. In general, there weren't any role changes of installation Remedial Project Manager (RPM), Restoration Advisory Board (RAB). Army risk assessors may be contacted by contractor(s) to discuss strategies at various stages. The Army BTAG is seen as a valuable technical resource to RPMs and contractors. The TSERAWG can be a venue to coordinate technical details among the services. It is anticipated that 30% of the work should be in the form of PBCs in FY04. The website for more information is the following: http://aec.army.mil/usaec/cleanup/pbc00.htm.

How Ecological-Based Cleanup Goals Were Applied During the Soil Cleanup Operations at Joliet Army Ammunition Plant (AAP)

Elizabeth Ferguson, Army Corps of Engineers
Laurie Haines, U.S. Army Environmental Center
June 2004

The Army Ammunition Plant is located in Joliet, Illinois. The site covers 19 square miles, with some excess property present also. Also, 50,000 acres were designated as tall grass prairie. It was important that the PRGs were 'protective of plant health' and EPA wanted additional studies using native grasses and plants. The Army used GIS to evaluate the data points to “field truth” for visible signs of environmental stress and used human health numbers to compare with plant LOAELs and NOAELs. GIS was used to show what the extent of cleanup would be if certain specific controversial criteria were used. This visualization and the subsequent comparison to more moderate criteria provided consensus on the excavation strategy. The excavation design was to focus on individual high hits. FFS had multi-agency and stakeholder support.

Ecological Enhancements and Remedial Strategies

Lesley Kordella
Wildlife Habitat Council
June 2004

The Wildlife Habitat Council (WHC) and their role in the Interstate Technical Regulatory Council (ITRC) was discussed. The WHC is a non-profit, non-lobbying, environmental strategy group. Executive Order 13112 (dated, 2/3/99) requires use of native species as part of remedy when re-establishing habitat. The WHC advises and helps coordinate trustees to help achieve good land use. She presented an example where the WHC provided assistance in improving the habitat of a soil-waste management unit where a cap was installed. They showed that there were reductions in the concentrations of vinyl chloride in the groundwater. Based on this they were able to install a permeable cap and vegetate the cap and the area. The local community was also involved. However, there were some regulatory, social/community, technical, and institutional obstacles to these ecological enhancements. The WHC is looking for pilot sites. Their mission is to improve habitat for wildlife and their goals may be facilitated through additional FS contributions. The ITRC has an MOU with DoD and thus may serve as a funding mechanism.

Risk and Uncertainty Characterization in Ecological Risk Assessment

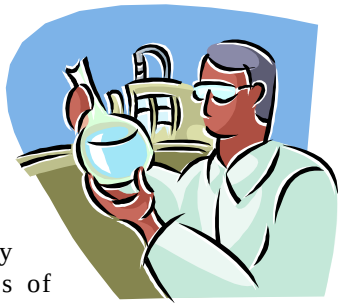
Katherine von Stackelberg
Menzie-Cura & Association
June 2004

This presentation reports on data from risk assessments conducted for United States Army sites to:

- Identify human health and ecological pathways that are most often considered at Army sites;
- Identify chemical and exposure pathway combinations associated with human health and ecological risk estimates that exceed regulatory thresholds; and,
- Identify, categorize, and score the importance of sources of uncertainty in Army risk assessments.

This work identifies and recommends better analytical practices and targeted scientific research for improving risk estimates at Army sites. The report identifies important sources of uncertainty (lack of knowledge) where such additional analysis or research may improve confidence in these estimates. The categorization and scoring of uncertainty sources builds on previous work for the United States Army Corps of Engineers (USACE) regarding dredged material management. Three tools were developed and used to evaluate sources of uncertainty:

- A "conceptual model database" that contains descriptions of all complete and incomplete pathways considered in each risk assessment
- A “risk database” that contains records for each chemical of potential concern (COPC) and exposure pathway combination associated with an exceedance of a regulatory threshold, which is defined as an ecological toxicity quotient (TQ) equal to or greater than one, a human health hazard index (HI) equal to or greater than one, or an incremental lifetime cancer risk (ILCR) equal to or greater than one in 10,000



- A set of criteria and summary forms for scoring sources of uncertainty in ten risk assessments (case studies) with respect to magnitude of uncertainty, reducibility, and quantifiability of uncertainty sources.

The report uses these tools to identify those components of Army risk assessments where judicious application of resources will effectively and likely improve risk estimates.

Review of Ecological-based Risk Management Approaches used in Army Superfund Sites

S. Poucher and G. Tracey, Science Applications International Corporation
Mark Johnson, U.S. Army Center for Health Promotion and Preventativee Medicine
Laurie Haines, U.S. Army Environmental Center
June 2004

The contribution of ecological risks to risk management decisions was reviewed for Army CERCLA sites with recent Records of Decision (ROD). Out of 38 Army sites with CERCLA RODs that were completed between 1995 and 2004, only five appeared to have operable units with remediation driven more by findings from ecological risk assessments (ERA) than by human health (HH) risk assessments. The five selected sites were Rocky Mountain Arsenal, CO; Tooele Army Depot, UT; Aberdeen Proving Ground, MD; Fort Richardson's Eagle River Flats; and Fort Wainwright, both in AK. Each site was reviewed through a reverse discovery process, starting with the ROD and working backward to the risk assessments that contributed to the basis for remedial action decisions. The ROD for each site was reviewed to establish the ecologically-based Remedial Action Objectives (RAOs), and to evaluate the process through which the preferred remedial alternatives were selected. EPA requires that remedial alternatives be evaluated relative to nine performance criteria:

- Threshold Criteria that must be met (protect human health and the environment and to meet all regulatory requirements)
- Modifying Criteria (effectiveness and permanence of solutions)
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost-effectiveness
- Balancing Criteria (acceptance by state agencies and the community)

The Criteria are intended to serve as a standard framework to assist in determining the preferred action, with consideration for effectiveness and efficiency.

The case studies revealed that the evaluation of Threshold Criteria to "protect the environment" in the ROD generally does not provide a synthesis or other direct link to the findings from the ERA. In addition, HH goals are often applied as default interim action levels for protection of ecological receptors. In some cases, there are indirect references to the ERA in the form of caveats (e.g., the small range of impact relative to the range of exposed species precludes the need for remediation) applied with or without structured studies and/or documented approach to support them. Application of the Modifying Criteria for short-term effectiveness of remedial alternatives ranged from evaluating the rate at which ecological benefits would emerge to the environmental harm that would occur during certain remediation alternatives. Generally, these assessments are not directly supported by ecological risk assessment studies. Some other factors that emerged from the case study review were that actions regarding ecological risk are often deferred due to the uncertainty of the assessment, with supplementary field studies as follow-on activities. Hence, acceptable uncertainty becomes a major component of ecological risk management. Another un-harness aspect of the approach to incorporating ERAs within the ROD framework is that size and spatial complexity of operable units targeted for remediation become important de facto variables in risk management decisions, yet the technical basis for decisions that incorporate landscape parameters is generally lacking. Also, in cases where the state or community has been very involved in reviewing plans for the site, the Responsiveness Summary section of the ROD may contain important details regarding the risk assessment and risk decisions that are not captured elsewhere. Given the large number of decisions that must be made for contaminated site assessments, from problem formulation and remedial action objectives to selecting assessment and measurement endpoints, to developing metrics for characterizing risk and describing uncertainty, documenting critical decision pathways in ecological risk management is not a "cook book" task. Improved risk management will likely require more formal documentation of decision criteria to become more technically defensible. However, the case studies demonstrated that it is equally important to maintain flexibility to assure that each site is evaluated using all information that is pertinent in characterizing risks as well as potential solutions.

Plant Uptake: Is There Perchlorate in Our Fruits and Vegetable

Jaqueline Trevino,
Air Force Institute for Operational Health
September 2004

Perchlorate salts such as ammonium perchlorate are critical to the effective and safe use of rockets and missiles. It is considered a national technical asset vital to our Nation's strategic defense programs employed by the U.S. Department of Defense and by NASA in space exploration.

Perchlorate is also used in highway safety road flares, air bag inflation systems, explosives, matches, fireworks and tracer munitions. Its use also consists of a wide range of industrial processes and until recently was used to treat hyperthyroidism. Chilean fertilizer also contains naturally occurring perchlorate. The U.S. Geological Service has found perchlorate in a variety of mineral and selected natural minerals from the southwestern United States. Due to its high solubility in water and stability in the environment and soils, use of perchlorate is a concern as a source of surface and ground water contamination. The Lower Colorado Region is of particular concern for potential exposure as crops are irrigated with water containing low levels of perchlorate. This presentation outlines laboratory studies of lettuce exposed to perchlorate and crop studies of vegetables and fruits grown in this area. Ongoing studies from Federal agencies will also be presented.

Triad Assessments: When and Where Can it Help You?

Corie Rocket
CH_2M Hill
September 2004

The Triad Approach has been promoted by USEPA as an efficient and cost-effective approach to hazardous material site remediation. The Triad Approach is intended to provide a framework to integrate new and established characterization and remediation technologies combined with smart work strategies to achieve "better" cleanups. The three components of the Triad Approach include systematic project planning, using a dynamic work strategy, and using real-time measurement technologies in a field program. Emphasis is placed on the development of conceptual site models, a flexible work plan, and defining data quality objectives prior to site evaluation. This approach may increase up-front costs, but is expected to save time and money over the course of site closure activities.

Projects that have implemented the Triad Approach provide important lessons-learned and regarding strategic planning approaches. Stakeholder and state regulatory acceptance are also key elements for successful implementation of the Triad Approach. Implication of the Triad Approach for risk assessment include the need for extensive up-front involvement of a risk assessor and the ability to apply risk assessment models based on real-time measurements. For sites that require extensive ecological assessment of multiple contaminants, particularly aquatic assessments, implementation of the Triad Approach required may require innovative solutions and more extensive planning.

Using Screening-Level Cumulative Risk Assessment to Manage Large Data Sets Effectively

Sandy Smith, URS Austin, Texas
September 2004

Tier 1 screening-level assessments usually involve comparing maximum detected concentrations to risk-based screening levels. However, because of the conservative nature of risk-based screening levels, this type of assessment often is unable to definitively distinguish between sites that require further evaluation and those that do not. Ideally, a screening-level assessment: 1) effectively identifies no further action sites; 2) provides enough information to prioritize sites for further action; 3) provides the kind of information that can be used to focus the site-specific risk assessment, if one is required; and 4) is acceptable to the regulators for making risk management decisions.

One such tool is a screening-level cumulative (multiple constituents, multiple pathways of exposure) risk assessment that applies risk-based screening levels (RBSL), uses calculated exposure point concentrations (EPC) rather than maximum detected concentrations, sums the ratios of the constituent-specific EPC to the RBSL, and converts the sum of the ratios to cumulative cancer risk and non-cancer hazard estimates. Example uses of this tool include:

- At a commercial site in Indiana, evaluated a large database containing multiple years of historical data using ASTM RBCA Tier 1 look-up values and calculated Tier 2 values for exposure pathways not included in Tier 1. Demonstrated that majority of site qualified for no further action.

- At a commercial site in Pennsylvania, evaluated confirmation samples results on a real-time basis, during dig and haul remedial action, to determine remediation end point. Remediation end point based on cumulative risk rather than fixed remediation goals.

- At Little Rock AFB, Arkansas, the RFI scope of work included risk screening, but not site-specific risk assessment. Used cumulative risk screening at the RFI stage to identify media, constituents, and exposure pathways that required further evaluation. Set the stage for very focused site-specific risk assessments in the CMS phase.

- At former Chanute AFB, screening numerous sites on an abbreviated schedule to identify "problem" sites early in the process. This permits time-critical planning to fast-forward to solutions within the timeframe for last remedy in place.

Cumulative screening-level risk assessments at the former Chanute AFB involve three components: 1) quantitative evaluation of cumulative residential and industrial worker risk; 2) weight-of-evidence evaluation of potential "hot spots," and, 3) weight-of-evidence evaluation of soil-to-groundwater migration. A specific example of the use of cumulative risk screening at one Chanute AFB site was presented to demonstrate the method and how results can be used to arrive at an end point faster.